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[5558]-101

**F.E. EXAMINATION, 2019
ENGINEERING MATHS—I
(2015 PATTERN)**

Time : Two Hours

Maximum Marks : 50

- N.B. :—** (i) Neat diagrams must be drawn wherever necessary.
(ii) Figures to the right indicate full marks.
(iii) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.
(iv) Assume suitable data, if necessary.
(v) Attempt Q. No. 1 or 2, Q. No. 3 or 4, Q. No. 5 or 6, Q. No. 7 or 8.

1. (a) Reduce the following matrix to its normal form and hence find its rank : [4]

$$A = \begin{bmatrix} 1 & 2 & 1 & 0 \\ -2 & 4 & 3 & 0 \\ 1 & 0 & 2 & -8 \end{bmatrix}.$$

- (b) Find eigen values and eigen vector corresponding to highest eigen value of the following matrix : [4]

$$A = \begin{bmatrix} -2 & -8 & -12 \\ 1 & 4 & 4 \\ 0 & 0 & 1 \end{bmatrix}.$$

- (c) Solve the equation $x^3 - 1 = 0$ by applying Demoivre's theorem. [4]

P.T.O.

Or

2. (a) Investigate for what values of k the system of equations $x + y + z = 1$, $2x + y + 4z = k$, $4x + y + 10z = k^2$ have infinite number of solutions. [4]

- (b) Find locus of z such that : [4]

$$|z + 1| = |z - i|.$$

- (c) If $\sin(x + iy) = u + iv$ prove that $u^2 \operatorname{cosec}^2 x - v^2 \sec^2 x = 1$ and $u^2 \sec^2 x + v^2 \operatorname{cosec}^2 x = 1$. [4]

3. (a) Solve any one : [4]

- (i) Test for convergence the series $\sum_{n=1}^{\infty} \frac{2n-1}{n(n+1)(n+2)}$.

- (ii) Test the convergence of the series :

$$1 - \frac{1}{\sqrt{2}} + \frac{1}{\sqrt{3}} - \frac{1}{\sqrt{4}} + \dots$$

- (b) Expand $\log(1 + x + x^2 + x^3)$ upto the term in x^8 . [4]

- (c) Find the n th derivative of $y = \frac{x}{(x-1)(x-2)(x-3)}$. [4]

Or

4. (a) Solve any one : [4]

- (i) Evaluate :

$$\lim_{x \rightarrow 0} \frac{e^x - 1 - x}{\log(1+x) - x}.$$

- (ii) Evaluate :

$$\lim_{x \rightarrow 0} (\sin x)^{\tan x}.$$

(b) Expand $x^3 + 7x^2 + x - 6$ in powers of $x - 3$. [4]

(c) If : [4]

$$y = e^{\tan^{-1} x},$$

prove that :

$$(1 + x^2)y_{n+2} + [2(n + 1)x - 1]y_{n+1} + n(n + 1)y_n = 0.$$

5. Solve any two :

(a) If $z = \tan(y + ax) + (y - ax)^{3/2}$, find the value of $\frac{\partial^2 z}{\partial x^2} - a^2 \frac{\partial^2 z}{\partial y^2}$. [6]

(b) If $x^2 = au + bv$ and $y^2 = au - bv$, then prove that : [6]

$$\left(\frac{\partial u}{\partial x}\right)_y \cdot \left(\frac{\partial x}{\partial u}\right)_v = \left(\frac{\partial v}{\partial y}\right)_x \cdot \left(\frac{\partial y}{\partial v}\right)_u.$$

(c) If $u = \sin^{-1}(x^2 + y^2)^{1/5}$, then prove that : [7]

$$x^2 u_{xx} + 2xy u_{xy} + y^2 u_{yy} = \frac{2}{5} \tan u \left[\frac{2}{5} \tan^2 u - \frac{3}{5} \right].$$

Or

6. Solve any two :

(a) If $f(x, y) = \frac{1}{x^2} + \frac{1}{xy} + \frac{\log x - \log y}{x^2 + y^2}$, then prove that : [7]

$$x \frac{\partial f}{\partial x} + y \frac{\partial f}{\partial y} + 2f = 0.$$

(b) If $u = f(r)$ where $r = \sqrt{x^2 + y^2}$, then prove that : [6]

$$u_{xx} + u_{yy} = f''(r) + \frac{1}{r} f'(r).$$

- (c) If $z = f(x, y)$ where $x = e^u \cos v$ and $y = e^u \sin v$, then prove that : [6]

$$y \frac{\partial z}{\partial u} + x \frac{\partial z}{\partial v} = e^{2u} \frac{\partial z}{\partial y}.$$

7. (a) If : [4]

$$x = uv, y = \frac{u + v}{u - v}$$

find :

$$\frac{\partial(u, v)}{\partial(x, y)}.$$

- (b) If $u = x + y + z, v = x^2 + y^2 + z^2, w = x^3 + y^3 + z^3$ find $\frac{\partial x}{\partial u}$. [4]
- (c) Divide the number 120 into three parts so that the sum of their products taken two at a time shall be maximum. [5]

Or

8. (a) Examine for functional dependence and independence $u = x + y + z, v = x^2 + y^2 + z^2, w = xy + yz + xz$. [4]
- (b) Find the percentage error in the area of an ellipse with an error of 1% is made in measuring its major and minor axis. [4]
- (c) Find the extreme values of $f(x, y) = x^3 + y^3 - 3axy, a > 0$. [5]

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[5558]-102

**F.E. EXAMINATION, 2019
ENGINEERING CHEMISTRY
(2015 PATTERN)**

Time : Two Hours

Maximum Marks : 50

- N.B. :—**
- (i) Neat diagrams must be drawn wherever necessary.
 - (ii) Figures to the right indicate full marks.
 - (iii) Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.
 - (iv) Assume suitable data, if necessary.

1. (a) Define scale and sludge. Give the causes, disadvantages of scales in boiler. [6]
- (b) Explain titration curve of conductometric titration between strong acid and weak base. [3]
- (c) Define the following terms : [3]
- (i) Auxochrome
 - (ii) Red shift
 - (iii) Blue shift.

Or

2. (a) Discuss the titration curve for pH metric titration between mixture of strong acid-weak acid and strong base. Give reactions involved. [6]
- (b) Give any *three* principles of green chemistry. [3]

P.T.O.

- (c) A zeolite softner was completely exhausted and was regenerated by passing 100 litre of NaCl containing 150 gm/lit of NaCl. How many liters of a sample of water containing hardness 600 ppm can be softened by this softner ? [3]
- 3.** (a) What is glass transition temperature of a polymer ? [6]
Discuss any *five* factors affecting T_g value of polymer.
- (b) Define : [3]
- (i) Cetane number
- (ii) Power alcohol
- (iii) N.C.V.
- (c) 0.15 gm coal sample on burning in combustion chamber in presence of pure oxygen was found to increase weight of CaCl_2 U-tube by 0.08 gm and KOH U-tube by 0.49 gm. Calculate carbon and hydrogen present in coal sample on percent basis. [3]

Or

- 4.** (a) Draw neat labelled diagram and give construction, working of Bomb calorimeter to determine G.C.V. of fuel using corrected formula. [6]
- (b) Discuss bulk polymerization technique with diagram. Give its limitations. [3]
- (c) Give preparation reaction, properties and applications of SBR. [3]

5. (a) Explain production of hydrogen by steam reforming of methane and coke with reaction conditions and removal of CO_2 . [6]
(b) Give structure and properties of fullerenes. [4]
(c) Differentiate between diamond and graphite. [3]

Or

6. (a) What are carbon nano tubes (CNTs) ? Give their types and any *four* applications. [6]
(b) Give any *four* methods of storage of hydrogen. [4]
(c) Explain isotopes of hydrogen with applications. [3]
7. (a) Explain hydrogen evolution and oxygen absorption mechanism of wet corrosion. [6]
(b) State the principle of electroplating. Explain the method with diagram and reactions involved. [4]
(c) Define corrosion of metals. How the method of metal cladding is useful in protection of metal against corrosion.

Or

8. (a) Explain any *six* factors affecting corrosion. [6]
(b) Write Pilling Bedworth Ratio. Give its significance. What would be the type of oxide film in case of corrosion of (i) Mo and (ii) Al. State with reactions. [4]
(c) Describe any *one* method of cathodic protection of metal. [3]

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[5558]-103

F.E. (II Sem.) EXAMINATION, 2019

ENGINEERING PHYSICS

(2015 PATTERN)

Time : Two Hours

Maximum Marks : 50

1. (a) Explain the formation of Newton's rings. Prove that for Newton's rings in reflected light, the diameters of dark rings are proportional to the square root of natural numbers. [6]
- (b) What is reverberation time ? Explain any *two* measures to control reverberation time in an auditorium. [3]
- (c) In a plane transmission grating, the angle of diffraction for the second order principal maximum for the wavelength 5×10^{-5} cm is 30° . Calculate the number of lines/cm of the grating surface. [3]

Or

2. (a) What is piezoelectric effect ? Draw neat and labelled diagram for piezoelectric oscillator and hence explain its construction and working. [6]
- (b) Explain with suitable diagram how interference is used to design antireflection coating. [3]

P.T.O.

- (c) The average reverberation time of a hall is 1.5 sec and the area of interior surface is 3340 m^2 . If the volume of the hall is 13000 m^3 . Find absorption coefficient. [3]
3. (a) What is double refraction ? Explain Huygen's theory of double refraction. [6]
- (b) Calculate the number of acceptor to be added to a germanium sample to obtain the resistivity of $10 \text{ } \Omega\text{-cm}$. [3]
- (Given : $\mu = 1700 \text{ cm}^2/\text{volt-sec}$
 $e = 1.6 \times 10^{-19}\text{C}$)
- (c) What is holography ? Explain the process of Hologram recording. [3]

Or

4. (a) Define Fermi level in conductors and semiconductors. Show that the Fermi level lies at the centre of energy gap in an intrinsic semiconductor. [6]
- (b) A 20 cm long tube containing 48 c.c. of sugar solution rotates the plane of polarization by 11° . If the specific rotation of sugar is 66° , calculate the mass of sugar in the solution. [3]
- (c) List any *three* applications of solar cell. Explain any *one* of them in brief. [3]
5. (a) State and explain Heisenberg's uncertainty principle. Illustrate the principle of electron diffraction at a single slit. [6]

(b) What is De-Broglie hypothesis ? Derive an expression for de-Broglie wavelength for an electron when it is accelerated by potential difference V . [4]

(c) Lowest energy of an electron trapped in a potential well is 38 eV. Calculate the width of the well. [3]

$$(h : 6.63 \times 10^{-34} \text{ Js})$$

$$(m : 9.1 \times 10^{-31} \text{ kg})$$

Or

6. (a) Deduce Schrodinger's time independent wave equation. [6]

(b) An electron initially at rest is accelerated through a potential difference of 3000 V. Calculate for the electron wave the following parameters : [3]

(i) The de-Broglie wavelength and

(ii) The momentum.

$$(h : 6.63 \times 10^{-34} \text{ Js})$$

(c) Write down the conditions which are to be satisfied by well behaved wave function. [4]

7. (a) Explain optical and electrical properties of nanoparticles. [6]

(b) Explain how colloids are synthesized by the chemical route. [4]

(c) State any *six* applications of superconductivity. [3]

Or

8. (a) Explain the following terms of superconductivity with the help of necessary figure. Give formula and graph whenever necessary :
- (i) Meissner effect
 - (ii) Critical magnetic field. [6]
- (b) Give any *four* points to distinguish between Type I and Type II superconductors. [4]
- (c) State applications of nano-particle. Explain any *one* application. [3]

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[5558]-104

F.E. EXAMINATION, 2019
BASIC ELECTRONICS ENGINEERING
(2015 PATTERN)

Time : Two Hours

Maximum Marks : 50

N.B. :— (i) Figures to the right indicate full marks.

(ii) Neat diagrams must be drawn wherever necessary.

(iii) Use of electronic pocket calculator is allowed.

(iv) Assume suitable data, if necessary.

(v) Answer Q. 1 or Q. 2, Q. 3 or Q. 4, Q. 5 or Q. 6 and Q. 7 or Q. 8.

1. (a) Compare Half-wave and Full-wave rectifier on the basis of below parameters : [6]

(1) I_{dc}

(2) I_{rms}

(3) Efficiency

(4) Ripple factor

(5) P/V

(6) Output waveform.

(b) Draw output characteristics of BJT in CE configuration. Indicate and explain *three* regions of operations. [6]

P.T.O.

Or

- 2.** (a) Explain with neat diagram the positive clamper circuit with waveforms. [6]
- (b) Draw and explain BJT as a switch along with its region of operation. [6]
- 3.** (a) Draw the diagram of IC555 as an Astable multivibrator, along with its waveform and write the T_{ON} and T_{OFF} equations. [6]
- (b) Implement full-adder using logic gates along with its truth-table and write the equation for SUM and CARRY. [6]

Or

- 4.** (a) Draw and explain Integrator circuit using op-amp with its output equation. [6]
- (b) Mention types of shift registers and explain serial input serial output (SISO) shift register. [6]
- 5.** (a) Draw the symbol and explain operation of TRIAC along with its V-I characteristics. [6]
- (b) Draw and explain Linear Variable Differential Transducer (LVDT) along with its transfer characteristics. [7]

Or

- 6.** (a) Define and explain selection criteria for transducers. [6]
- (b) Draw and explain the block diagram of Digital Thermometer. [7]

7. (a) A carrier of 20 V peak and frequency 1 MHz is amplitude modulated (AM) by a sine wave of 10 V peak and frequency 1 kHz. Determine the modulation index for the modulated wave and draw the frequency spectrum for AM wave. [7]
- (b) Compare Twisted pair, co-axial and optical fibre cable. [6]

Or

8. (a) Define frequency modulation (FM) and explain : [7]
- (i) Frequency deviation
 - (ii) Modulation index
 - (iii) Frequency spectrum.
- (b) Define cellular concept and draw and explain GSM architecture. [6]

Total No. of Questions—8]

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[5558]-105

F.E. EXAMINATION, 2019

BASIC ELECTRICAL ENGINEERING

(2015 PATTERN)

Time : Two Hours

Maximum Marks : 50

N.B. :— (i) Answer Q. 1 or Q. 2, Q. 3 or Q. 4, Q. 5 or Q. 6 and Q. 7 or Q. 8.

(ii) Neat diagrams must be drawn wherever necessary.

(iii) Figures to the right indicate full marks.

(iv) Use of Non-programmable scientific calculator is allowed.

(v) Assume suitable data, if necessary.

Q.1 a) Define resistance and state its unit. What is the effect of temperature on resistance of the [i] metallic conductor [ii] alloys and [iii] insulator **[06]**

b) Find the induced emf in the coil having inductance of 0.15 H when [i] current of 10 A in the coil is switched off in 0.01 sec. [ii] same current is uniformly reversed in 0.01 sec. **[06]**

OR

Q.2 a) Obtain the expression for coefficient of coupling between two magnetically coupled coils. **[06]**

b) If the temperature coefficient of resistance for copper wire is 0.00393 per degree Celsius at 20 °C. Find the temperature coefficient of resistance at [i] 50 °C and [ii] 70 °C **[06]**

Q.3 a) Obtain the emf equation of 1-phase transformer. **[06]**

b) Obtain the expression for RMS value of alternating current in terms of its peak value. **[07]**

P.T.O.

OR

- Q.4** a) A 80 kVA, 1000/250 V, 1-ph 50 Hz transformer has iron loss of 800 W and full load copper loss 1200 W. Find [i] efficiency at full load and power factor = 0.8 lag. [ii] efficiency at half load and power factor = 1 lag. [06]
- b) The alternating current expression is given by $i = 14.14 \sin(100\pi t)$ Amp. Determine: [i] maximum value of current [ii] RMS value of current [iii] average value of current [iv] form factor [v] peak factor [vi] power consumed when it flows through resistance of 10Ω . [07]
- Q.5** a) Obtain the expression for power, when voltage $v = V_m \sin \omega t$ is applied across R-L series circuit. Draw the circuit diagram and phasor diagram. [06]
- b) State the relation between [i] phase voltage and line voltage [ii] phase current and line current in case of balanced delta connected 3-ph load. Using above relations, obtain the expressions for 3-ph active power and 3-ph reactive power. [06]

OR

- Q.6** a) What is series resonance?. Obtain the expression for resonant frequency. [06]
- b) The series circuit having resistance 5Ω and capacitance $150 \mu\text{F}$ is connected to 1-phase, 200 V, 50 Hz AC supply. Calculate - [06]
- [i] capacitive reactance X_c [ii] impedance [iii] current drawn by the circuit [iv] power factor [v] Active power and [vi] reactive power.
- Q.7** a) Derive the equations to convert Delta connected resistive circuit into equivalent star circuit. [06]
- b) Find equivalent resistance between AB for the circuit shown in fig. 7.b [07]

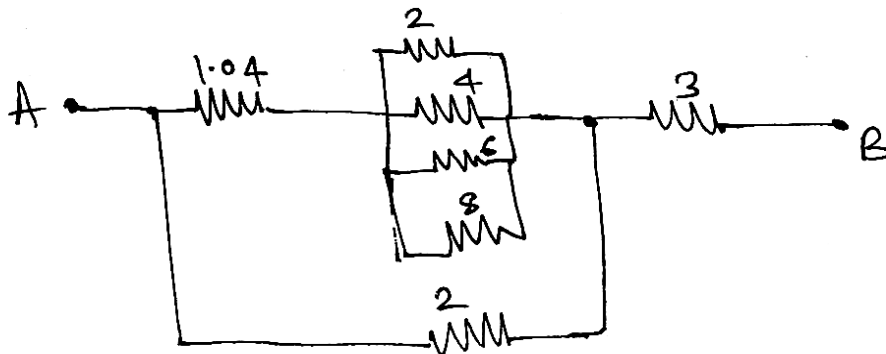


Fig. 7 (b)

OR

- Q.8 a) For the circuit shown in fig. 8.a find the current flowing through PQ [06]
using Kirchoff's laws.

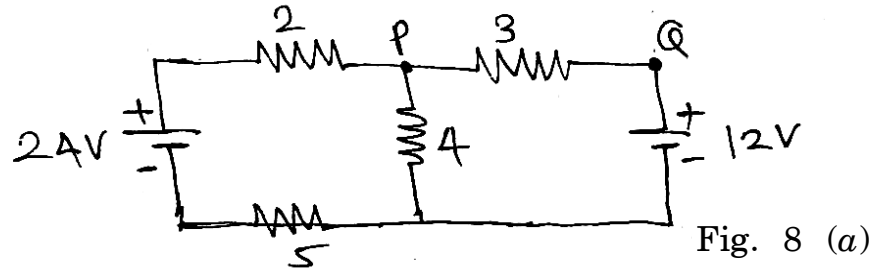


Fig. 8 (a)

- b) Write down the steps to find current through load resistance R_L using Thevenin theorem for the circuit shown in fig. 8.b. [07]

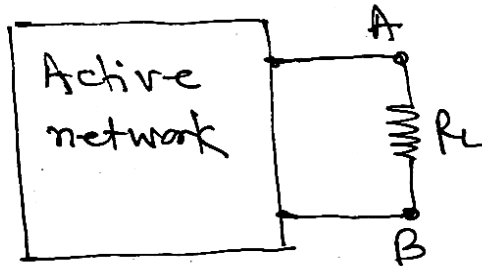


Fig. 8 (b)

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[5558]-106

F.E. (All Branches) EXAMINATION, 2019
BASIC CIVIL AND ENVIRONMENTAL ENGINEERING
(2015 PATTERN)

Time : Two Hours

Maximum Marks : 50

N.B. :— (i) Answer Q. 1 or Q. 2, Q. 3 or Q. 4, Q. 5 or Q. 6 and Q. 7 or Q. 8.

(ii) Neat sketches must be drawn wherever necessary.

(iii) Figures to the right indicate full marks.

(iv) Assume suitable data, if necessary.

(v) Use of electronic pocket calculator is allowed in the examination.

(vi) Use of cell phone is prohibited in the examination hall.

Q.1 a) Explain with a sketch, principle of surveying, “To work from whole to parts”. (04)

b) State any four necessities of valuation of a property. (04)

c) State any four functions of foundation. (04)

OR

Q.2 a) State any two applications of each: Construction Engineering; Quantity Surveying (04)

b) Briefly explain four tests for ascertaining quality of cement on site. (04)

c) What is differential settlement explain with a sketch? (04)

Q.3 a) Explain the term EIA? Explain Overlays method of EIA with a sketch. (05)

b) Following readings were taken on 4m levelling staff at 20 m interval. The readings were: 2.865, 3.345, 2.935, 1.950, 0.885, 2.790, 2.640, 1.540, 0.935, 0.850 and 0.190. The instrument was shifted after 5th and 8th reading. The work was started from a point whose Reduced Level was 250.000 m. Enter the readings for H.I. method and determine Reduced Levels of all the other stations. Also find the gradient of the line joining first and last staff stations. Apply usual arithmetic check. (07)

P.T.O.

OR

Q.4 a) What is Contour. Give any three applications of contour lines and three characteristics of contour lines with a sketch. (07)

b) Explain E-waste management briefly and state its need with respect to any three points. (05)

Q.5 a) Explain the principles of building planning with a sketch: 'Aspect' and 'Roominess' (08)

b) What is Air plane rule? Explain with a sketch. (05)

OR

Q.6 a) A owner proposed G + 1 construction on a plot with length equals to 1.5 times width of the plot. If built up area on Ground floor is 912 Sq. m and on First floor is 438 Sq. m. with permissible FSI = 1. Determine the size of the plot. (05)

b) Explain following with a sketch: "Privacy" and "Orientation" (08)

Q. 7 a) What is Air Pollution? Give any four sources of Air Pollution. (05)

b) Explain with suitable examples conventional and non-conventional energy sources with respect to any four points. (04)

c) Write short note on sources and preventive measure for Land pollution, any two points. (04)

OR

Q. 8 a) State any three advantages and dis-advantages of conventional sources of energy. (06)

b) What is Acid Rain? Give the chemical reactions takes places to form acid and also give three adverse effects of Acid rain. (07)

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[5558]-107

**F.E. EXAMINATION, 2019
ENGINEERING GRAPHICS—I
(2015 PATTERN)**

Time : 2 Hours

Maximum Marks : 50

Instructions:

1. *Solve Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.*
2. *Use only half imperial size drawing sheet as answer book.*
3. *Retain all construction lines.*
4. *Assume suitable data if necessary.*

Q.1 A line AB 90mm long, having its endpoint A is on HP and 20 mm in front of VP. The Plan length of the line AB is 70 mm and makes an angle of 40° with VP. Draw the Projections of line AB. Find the inclinations made by the line with HP and VP Also locate its traces. **12**

OR

Q.2 A circular plane lamina having diameter 60 mm is resting on one of its Circumferential point on HP in such a way that its plan appears as an ellipse having a major axis 60 mm long and minor axis is 40mm. Draw the projections, if the plan of the minor axis makes an angle of 40° to the VP. **12**

Q.3 A pentagonal pyramid having base edge 40 mm and axis 80 mm long is resting on HP on one of its base edge in such a way that the axis of the solid makes an angle of 50° to HP and the base edge on the HP makes an angle of 20° to VP, draw the projections of the solid when its apex is towards the observer. **13**

OR

Q.4 A Draw a cycloid of the rolling circle of diameter 55 mm along a straight line for one convolution and consider the starting point is farthest from the ground **07**

P.T.O.

B Draw the development of lateral surface for a pentagonal prism having a base edge 30 mm and axis height is 80 mm 06

Q.5 Figure shows a pictorial view of an object. By using first angle method of projections, draw; 13

- i. Draw the FV in the direction of X, [04]
- ii. Top View [04]
- iii. Sectional RHSV along the section line A-A for Figure A. [04]
- iv. Overall Dimensions [01]

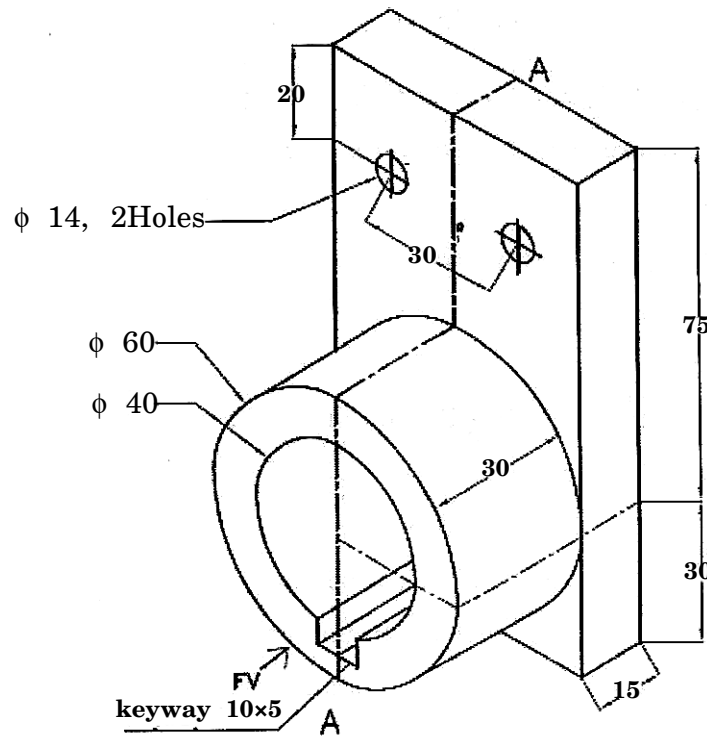


Fig. A

OR

Q.6 Figure shows a pictorial view of an object. By using first angle method of projections, draw; 13

- i. Draw the sectional FV along cutting plane line A-A, [04]
- ii. Top View, [04]
- iii. LHSV for figure B given below [04]
- iv. Overall Dimensions [01]

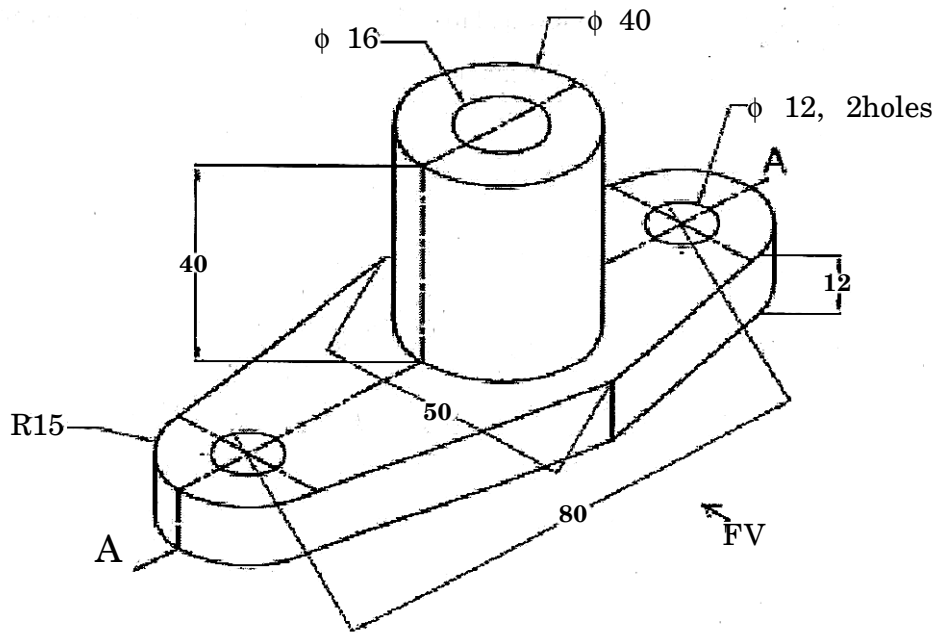


Fig. B

Q.7

Figure C shows the FV and SV of a bracket. Draw the isometric view and show the overall dimensions.

12

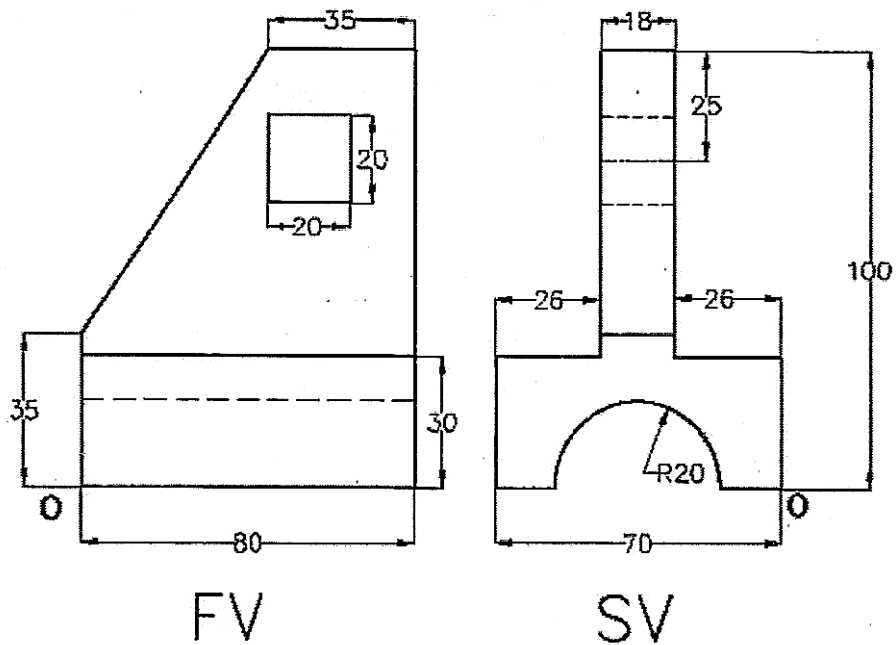


Fig. C

OR

Q.8

Figure D shows the front view and top view of an object. Draw an isometric view and show the overall dimensions

12

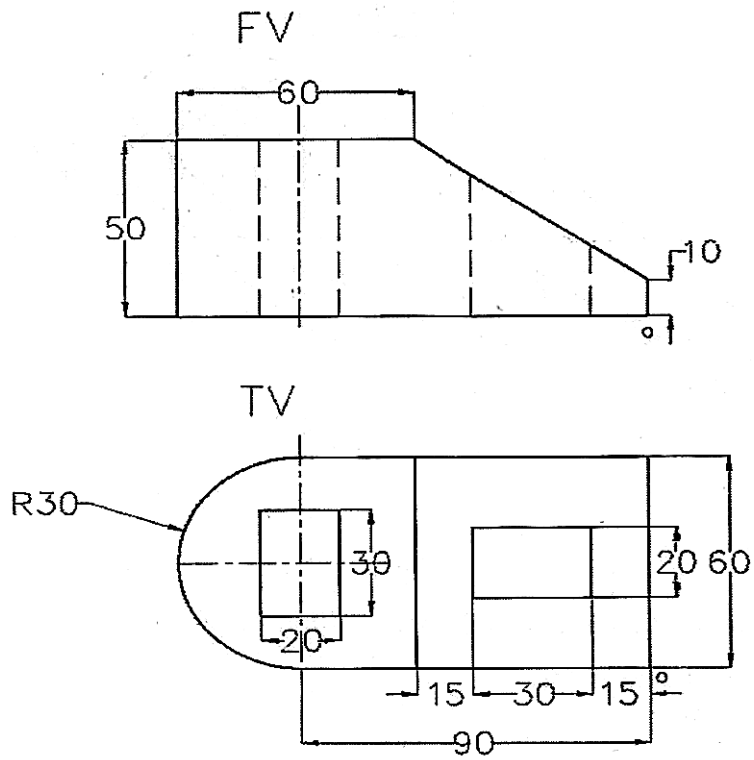


Fig. D

!!All the Best!!

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[5558]-108

F.E. EXAMINATION, 2019

ENGINEERING MATHEMATICS—II

(2015 PATTERN)

Time : Three Hours

Maximum Marks : 60

- N.B. :—** (i) Attempt Q. No. 1 or Q. No. 2, Q. No. 3 or Q. No. 4,
Q. No. 5 or Q. No. 6, Q. No. 7 or Q. No. 8.
- (ii) Neat diagrams must be drawn wherever necessary.
- (iii) Figures to the right indicate full marks.
- (iv) Use of electronic pocket calculator is allowed.
- (v) Assume suitable data, if necessary.

1. (a) Solve the following differential equations :

(i) $ye^{x/y} dx = (xe^{x/y} + y^2) dy$ [4]

(ii) $(1 + xy^2) dx + (1 + x^2y) dy = 0$. [4]

(b) A particle of mass m is projected vertically upward with velocity V_0 . Assuming that the air resistance is k times the velocity,

show that particle will reach maximum height in time $\frac{m}{k} \log$

$\left(1 + \frac{kv_0}{mg}\right)$. [4]

P.T.O.

Or

2. (a) Solve : $xy - \frac{dy}{dx} = y^3 e^{-x^2}$. [4]

(b) (i) A body originally at 80°C cools to 60°C in 20 minutes, the temperature of air being 40°C, what will be the temperature of the body after 40 minutes. [4]

(ii) A circuit consists of resistance R ohms and condenser of ε farads connected to a constant e.m.f. ε volts. If q/c is the voltage of condenser at time t after closing the circuit, show that : [4]

$$q/c = \varepsilon(1 - e^{-t/RC}).$$

3. (a) Find half-range cosine series for $f(x) = x^2$, $0 \leq x \leq \pi$. [5]

(b) Evaluate : $\int_0^{\infty} \frac{dx}{3^{4x^2}}$. [3]

(c) Trace the curve (any one) : [4]

(i) $y^2(a^2 - x^2) = a^3x$

(ii) $r = a \cos 2\theta$.

Or

4. (a) Evaluate : $\int_0^{2a} x^{7/2} (2a - x)^{-1/2} dx$. [4]

(b) Using DUIS, show that : [4]

$$\int_0^{\infty} \frac{e^{-x} - e^{-ax}}{x \sec x} dx = \frac{1}{2} \log \left(\frac{a^2 + 1}{2} \right), \quad a > 0.$$

- (c) Find the perimeter of cardioide $r = a(1 + \cos \theta)$. [4]
5. (a) Find the centre and radius of the circle $x^2 + y^2 + z^2 - 2x + 4y + 2z - 6 = 0$, $x + 2y + 2z - 4 = 0$. [5]
- (b) Find the equation of right circular cone with vertex at $(0, 0, 2)$, direction ratios of the generator are $0, 3, -2$ and the axis is z -axis. [4]
- (c) Find the equation of right circular cylinder of radius ' a ', whose axis passes through the origin and makes equal angles with the coordinates axes. [4]

Or

6. (a) Find the equation of the sphere through the circle $x^2 + y^2 + z^2 = 4$, $z = 0$ and cutting the sphere $x^2 + y^2 + z^2 + 10y - 4z - 8 = 0$ orthogonally. [5]
- (b) Find the equation of right circular cone whose vertex is at $(0, 0, 0)$, semi-vertical angle $\frac{\pi}{4}$ and axis along the line $x = -2y = z$. [4]
- (c) Find the equation of right circular cylinder of radius 2 whose axis is the line : [4]

$$\frac{x-1}{2} = \frac{y}{3} = \frac{z-3}{1}.$$

7. Attempt any *two* of the following :

(a) Evaluate : $\int_0^1 \int_0^{\sqrt{1+x^2}} \frac{dx dy}{1+x^2+y^2}$. [6]

(b) Evaluate : $\int_0^{\log 2} \int_0^x \int_0^{x+y} e^{x+y+z} dx dy dz$. [7]

(c) Find the C.G. of one loop of $r = a \sin 2\theta$. [6]

Or

8. Attempt any *two* of the following :

(a) Find the area bounded by the parabola $y = x^2$ and the line $y = x$. [6]

(b) Find the volume of the paraboloid $x^2 + y^2 = 4z$ cut-off by the plane $z = 4$. [7]

(c) Find the moment of inertia of the portion of the parabola $y^2 = 4ax$, bounded by the x -axis and the latus rectum, about X -axis if density at each point varies as the cube of the abscissa. [6]

Total No. of Questions—8]

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FE EXAMINATION, 2019

ENGINEERING MECHANICS

(2015 PATTERN)

Time : 2 Hours

Maximum Marks : 50

Instructions to the candidates:

1. Answer Q. 1 or Q. 2, Q. 3 or Q. 4, Q. 5 or Q. 6, Q.7 or Q.8
2. Figures to the right indicate full marks.
3. Assume suitable data, if necessary.
4. Use of electronic pocket calculator is allowed in the examination.
5. Use of cell phone is prohibited in the examination hall.

Q.1 (a) Determine the magnitude and direction of the resultant of three forces acting on the hook as shown in the Fig. 1a. (06)

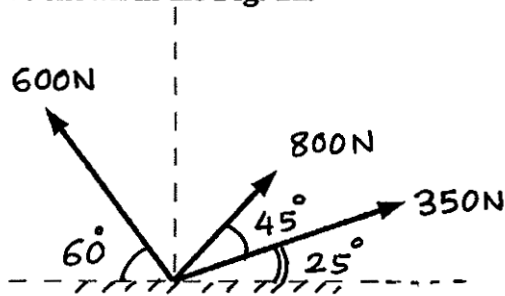


Fig. 1a

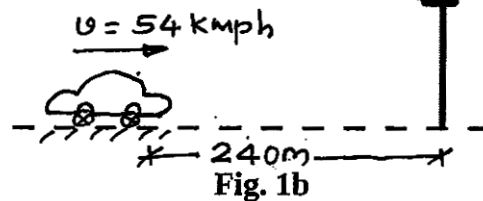


Fig. 1b

Q.1 (b) A motorist travelling with 54 kmph when he observes that a traffic light, 240m ahead of him, turns red. The traffic light is timed to stay red for 24 sec. If the motorist wishes to pass the light without stopping just as it turns green again, determine the required uniform deceleration of the car and also the speed with which he crosses the light signal. (Refer Fig. 1b) (06)

P.T.O.

OR

Q.2 (a) Locate the centroid of the plane lamina as shown in in Fig. 2a. (06)

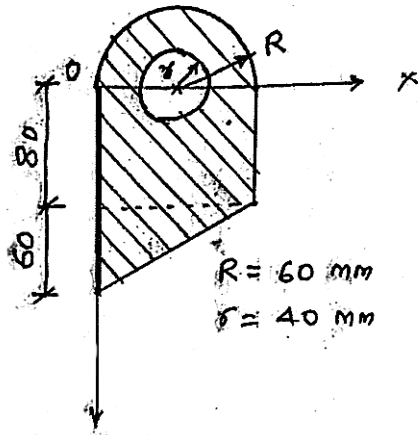


Fig. 2a

Q.2 (b) An 80 kg block rests on a rough horizontal plane as shown in the Fig. 2b. Find the magnitude of the force 'P' required to give an acceleration of 2 m/s^2 to the right. Take coefficient of kinetic friction as 0.20. (06)

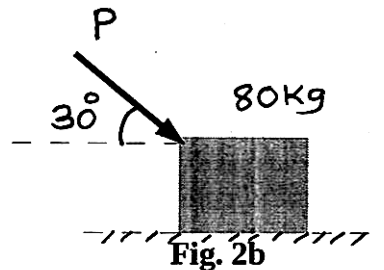


Fig. 2b

Q. 3 (a) A handball player throws a ball from A horizontally with a velocity 'u' m/s. Knowing that $d = 15\text{m}$, determine the range of the values of velocity for which the ball will strike the corner region BCD as shown in the Fig. 3a. (06)

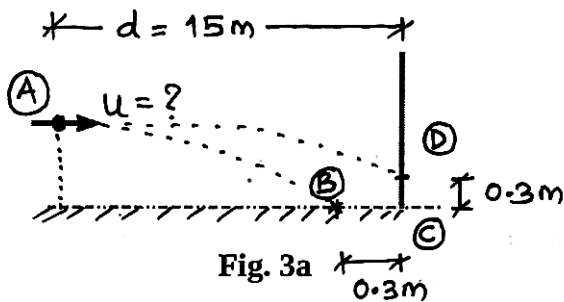


Fig. 3a

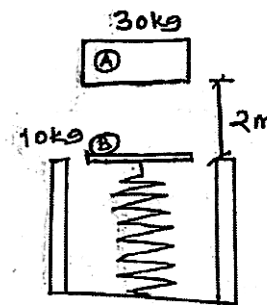


Fig. 3b

Q.3 (b) A 30 kg block dropped from a height of 2 m onto the 10 kg pan of spring scale as shown in the Fig. 3b. Assuming the collision to be perfectly plastic. Determine the maximum deflection (Compression) of the pan. The spring constant is $k = 20 \text{ kN / m}$. (06)

OR

Q. 4 (a) The polar coordinates of a particle moving along a plane curve are, $r = t^3 - 3t + 10$ and $\Theta = 0.5 r$, where 'r' is in meters, ' Θ ' is in radians and 't' is in seconds. Determine the acceleration of the particle at $t = 2 \text{ sec}$. (06)

Q.4 (b) A 20 Mg railroad car moving with 0.5 m/s speed to the right collides with a 35 Mg car which is at rest. If the coefficient of restitution between the two cars is $e = 0.65$ determine the speed of the cars after the collision. (06)

Q.5 (a) The beam AB with pin at 'B' and roller at 'A' is loaded as shown in the Fig. 5a. Determine the reaction at the supports A & B. (06)

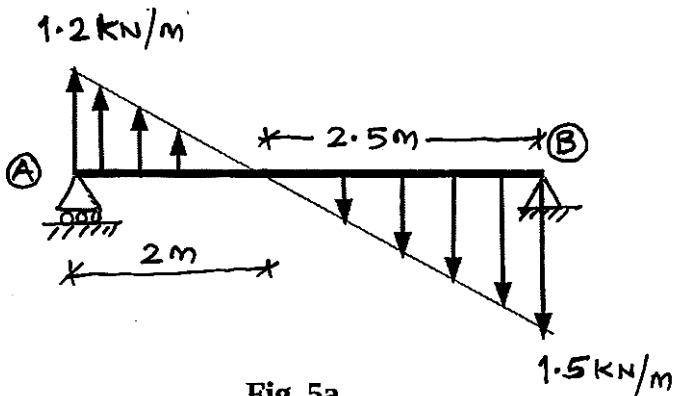


Fig. 5a

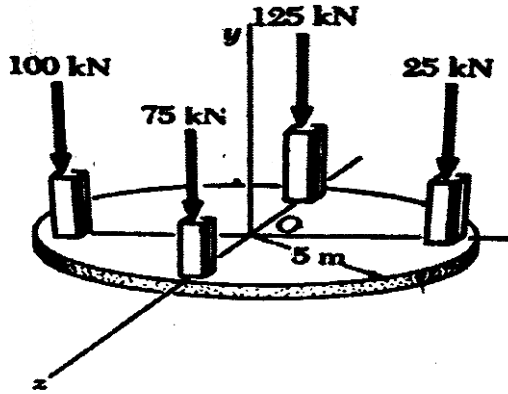


Fig. 5b

Q.5 (b) A circular mat foundation of radius 5m is supporting four columns at a distance of 4m from the centre 'O' as shown in the Fig. 5a. Determine the magnitude and position of the resultant force with respect to origin 'O'. (07)

OR

Q. 6 (a) Boom AB is supported by a pin at A and cable BC as shown in the Fig. 6a. Determine the reactions at pin A and the tension in the cable BC. (06)

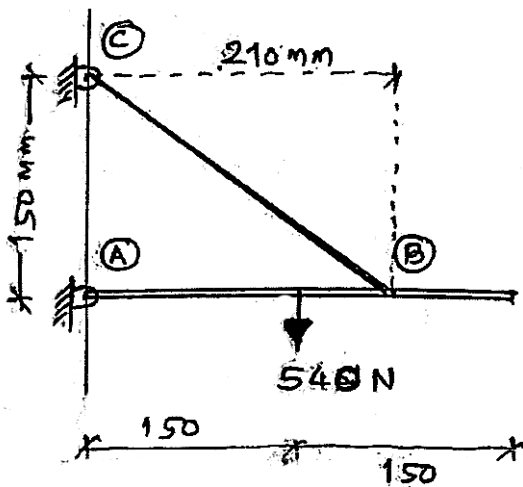


Fig. 6a

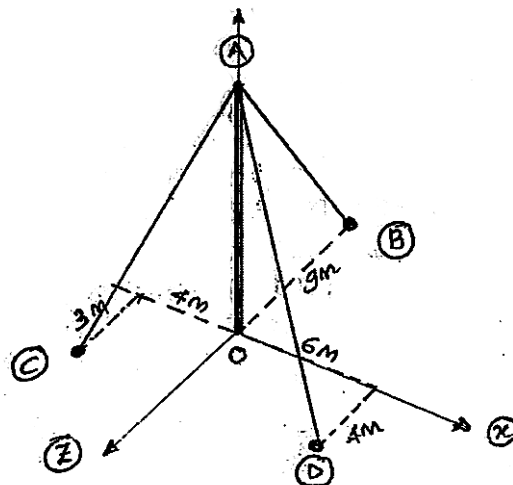


Fig. 6b

Q.6 b) The vertical boom OA is supported by three cables AC, AB and AD as shown in Fig. 6b. If the tension in the cable AD is 252 N, determine the tensions in the cables AB and AC. (07)

Q.7 (a) The truss supports vertical loads as shown in Fig. 7a. Determine the forces in all the members of the truss and state the nature of the forces in tabular form. (06)

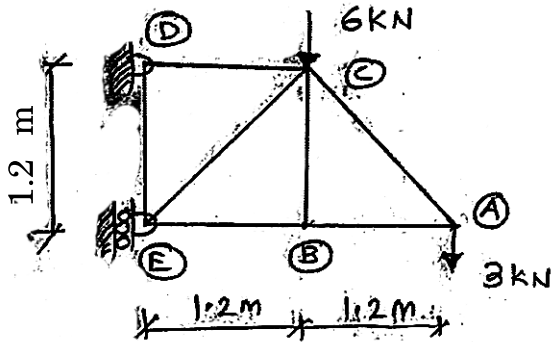


Fig. 7a

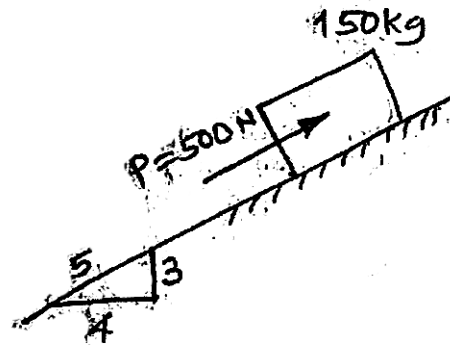


Fig. 7b

Q.7 (b) A 500 N force acting on the 150 kg block resting on the inclination as shown in the Fig. 7b. If the coefficient of static and kinetic friction are 0.25 and 0.20 respectively, state whether the block is in equilibrium or not. Also find the value of the frictional force. (07)

OR

Q. 8 (a) The truss supported and loaded as shown in the Fig. 7a, determine the forces in the members BC, CE and CD using section method. Also state the nature of the forces. (07)

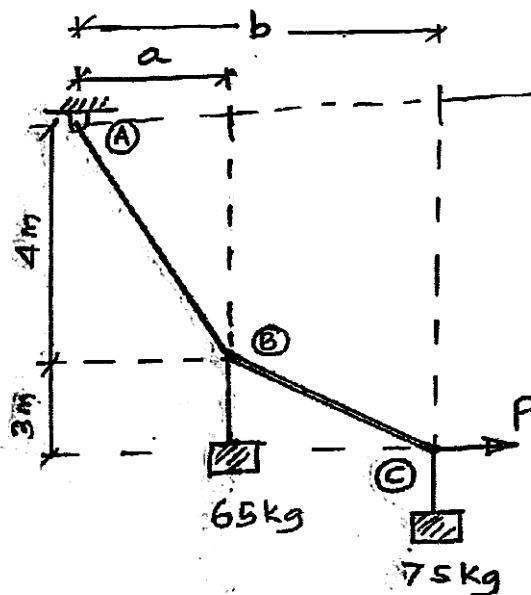


Fig. 8b

Q.8 (b) Cable ABC supports 65 kg and 75 kg loads at 'B' and 'C' points as shown in the **Fig.8b**. Determine the magnitude of the distances 'a' & 'b' (b = horizontal distance AC) to maintain equilibrium if $P = 800 \text{ N}$. **(06)**

Total No. of Questions—8]

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[5558]-110

F.E. EXAMINATION, 2019

BASIC MECHANICAL ENGINEERING

(2015 PATTERN)

Time : 2 Hours

Maximum Marks : 50

Instructions to the candidates:

- i) Neat diagrams must be drawn whenever necessary.
- ii) Black figures to right indicate full marks.
- iii) Assume suitable data, if necessary.
- iv) Use of non-programmable electronic calculator is permitted.
- v) Attempt four questions out of eight.: Q. No. 1 or Q. No. 2, Q. no. 3 or Q. No. 4, Q. No. 5 or Q. No. 5, Q. No. 7 or Q. No. 8.

Que.1) a) What is function of clutch? Explain the working of a single plate clutch with the help of neat sketch. **06**

b) What is Kinematic chain? Explain four bar mechanism and identify the types of kinematic pairs used in it. **06**

OR

Que.2) a) Explain steps involved in design process. **06**

b) How Engineering Materials are classified? Explain Plain Carbon Steel. **06**

Que.3) a) Draw block diagram of lathe machine. Explain function of headstock, tailstock and carriage. **07**

b) Explain Punching, piercing, perforating, notching operations in sheet metal working. **06**

OR

Que.4) a) Compare Welding soldering and brazing process. **06**

b) Explain working principle of drilling machine with block diagram and explain any three operations performed on it. **07**

P.T.O.

Que.5) a) Explain Following terms: 04
i. System, Surrounding and Boundary.
ii. kelvin Plank Statement of second law of thermodynamics.

b) Explain measurement of pressure using simple U Tube manometer. 04

c) A heat engine operates between source and sink temperatures of 05
235°C and 30°C respectively. If heat engine receives 35 KW from the source, find: (i) the net work done by the engine, (ii) the heat rejected to the sink by the engine and (iii) the efficiency of engine. Draw the sketch of system.

OR

Que. 6 a) State any two statements and limitations of first law of thermodynamics. 04

b) With neat sketch explain Open system, closed system and isolated system. 04

c) A U Tube manometer is used to measure a pressure of a gas in the pipe. The level of liquid in the manometer arm open to the atmosphere is 170mm lower than level of liquid connected to the gas pipe. The liquid in the manometer has specific gravity of 0.8. Find the absolute pressure of the gas, if barometer reads 76 cm of mercury. Take the density of mercury as 13600 kg/m³. Draw the sketch of system. 05

Que.7 a) Draw Layout of Hydroelectric Power plant and explain the energy conversion process and its limitations. 06

b) Explain working of Four Stroke cycle CI engine with neat sketch. 06

OR

Que.8 a) With neat sketch explain working of Vapour compression refrigeration process. 06

b) Compare : 06
(i) Water tube and Fire tube Boiler
(ii) Impulse and Reaction turbine